CONTROL SYSTEM SOLUTIONS

GCM196

General Purpose Automotive Grade Control Module

P/N: GCM-1793-196-1503

The GCM196 is a general purpose control module. The module has 3 CAN buses, making it suitable for system supervisory applications in which communication with many system components is necessary. The extensive amount of inputs and outputs, memory and processing capability make this module suitable for a wide variety of general purpose applications. The dual processors make this module suitable for safety critical applications where redundant processing is required.

The GCM196 is part of a family of rugged, automotive-grade production controllers that use a software development process based on MATLAB/Simulink, known as Raptor-Dev. Raptor-Dev significantly speeds up algorithm development by using automatic code generation. In addition, developers can quickly test application software on their PCs with a built-in onscreen PC simulation. See the next page for more details.

- MATLAB Simulink Programmable
- Processor
  - Infineon Tricore TC1793
  - 200/260MHz
- Memory
  - 4MB Flash
  - 96KB EEPROM
  - 256 KB Internal RAM
- 45 Inputs
  - 1 Wake Input
  - 31 Analog Inputs
  - 8 Digital Inputs
  - 5 Frequency Inputs
- 45 Outputs
  - 39 Low Side Drivers
  - 3 H-Bridges
  - 1 High Side Driver
  - 1 Main Power Relay Driver
- 6-16 V Operating Voltage
- Communication
  - 3 CAN 2.0B
  - 1 LIN
- Environmental
  - -40°C to +105°C Operating
  - IP6k9k Compliant
- Required Compiler
  - Hitech Compiler v3.4.5.11
- Aluminum Construction

What is a Raptor Control Module?

Nearly all complex electro-mechincal systems—especially those in automotive applications—such as internal combustion engines, hydraulic systems, or hybrid electric powertrains require complex control algorithms. Hand-coding such complicated control logic in traditional programming languages like C, C++, or Java can amount to hundreds of thousands of lines of code. Writing and debugging code in this manner can be time consuming, tedious, and labor intensive.

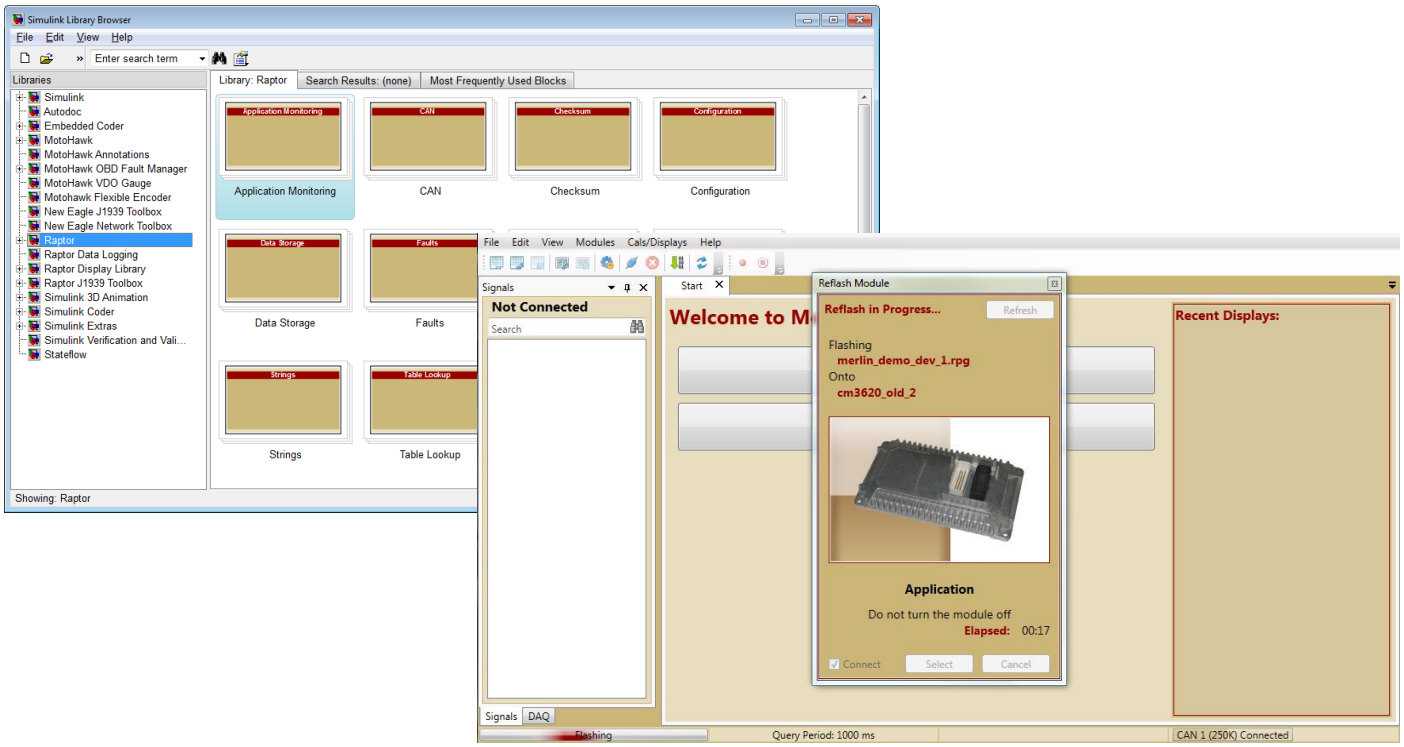
Raptor
Model-Based Development Tool

New Eagle's line of Raptor-compatible controllers and complimentary Raptor-Dev software offer an alternative approach to the traditional programming languages: These controllers allow developers to leverage the graphical programming environment of MATLAB Simulink to quickly and easily create, edit, and debug application software. But what exactly is Raptor-Dev software and how does it allow developers to create software in Simulink for control modules?

MATLAB SIMULINK

Raptor-Dev is a library of customizable Simulink blocks that allows developers to quickly create custom software for Raptor-compatible controllers. Developers work directly in the Simulink environment with Raptor-Dev blocks as well as native Simulink blocks and features. The Raptor-Dev library blocks facilitate interaction between Simulink and all of the input, outputs, and communication channels of the control module hardware. For example, the Raptor-Dev library includes blocks to read analog inputs or actuate low side drive outputs. The Raptor-Dev library also contains other useful block-sets for many applications, such as OBD fault management and data logging. Even J1939 or Modbus Raptor library blocks are available. Common to all of the Raptor library blocks is that they are easy and intuitive to use. The Raptor-dev libraries vastly reduce software complexity, speed-up development, and they eliminate the need to understand low-level logic necessary to manage controller hardware.

Once an application is ready for programming, code can be directly compiled from Simulink into an application file which can then be programmed onto the Raptor-compatible module though the windows-based Raptor-Cal software and a USB-to-CAN hardware interface. Raptor-Cal also allows users to calibrate application parameters in real-time.



Hardware

Microprocessor	Infineon Tricore TC1793
Clock Speed	200/260MHz
Environmental	IP6k9k Compliant
Operating Temp	-40°C to +105°C

Memory Segments

Memory Segment	Size
FLASH CB	63 KB
FLASH ASW0	1919 KB
FLASH ASW1	1535 KB
FLASH DATA	495 KB
EEPROM	71 KB
INTERNAL RAM1	128 KB
INTERNAL RAM2	128 KB

Communication Channels

Channel	Functions	Options
CAN1	CAN	125k 250k 500k 1000k
CAN2	CAN	125k 250k 500k 1000k
CAN3	CAN	125k 250k 500k 1000k

Note: CAN 1: 250k Baud Default. CAN 2: 250k Baud Default. CAN 3: 250k Baud Default.

Inputs

Resourse	Functions	Voltage Ranges	Pull-Downs/Ups	Note
WAKE_INPUT1	digital_in	0 - 5 V	2.9k PD	Key Switch, Pin K050
INPUT2	analog_in	0 - 5 V	2.15k PU	Pin A016, Pullup to 5V
INPUT3	analog_in	0 - 5 V	2.15k PU	Pin A017, Pullup to 5V
INPUT4	analog_in	0 - 5 V	422k PD	Pin A018
INPUT5	analog_in	0 - 5 V	681k PU	Pin A019, Pullup to 5V
INPUT6	analog_in	0 - 5 V	681k PU	Pin A037, Pullup to 5V
INPUT7	analog_in	0 - 5 V	681k PU	Pin A038, Pullup to 5V
INPUT8	analog_in	0 - 5 V	4.64k PU	Pin A040, Pullup to 5V
INPUT9	analog_in	0 - 5 V	681k PU	Pin A041, Pullup to 5V
INPUT10	analog_in	0 - 5 V	681k PU	Pin A042, Pullup to 5V
INPUT11	analog_in	0 - 5 V	681k PU	Pin A055, Pullup to 5V
INPUT12	analog_in	0 - 5 V	422k PD	Pin A059
INPUT13	analog_in	0 - 5 V	2.15k PU, 31.6k PD	Pin A062, Pullup to 5V
INPUT14	analog_in	0 - 5 V	681k PU	Pin A082, Pullup to 5V
INPUT15	analog_in	0 - 5 V	2.15k PU, 31.6k PD	Pin A084, Pullup to 5V
INPUT16	analog_in	0 - 5 V	4.64k PU	Pin A097, Pullup to 5V
INPUT17	analog_in	0 - 5 V	422k PD	Pin A102
INPUT18	analog_in	0 - 5 V	422k PD	Pin A103
INPUT19	analog_in	0 - 5 V	2.15k PU	Pin A105, Pullup to 5V
INPUT20	analog_in	0 - 5 V	681k PU	Pin K011, Pullup to 5V
INPUT21	analog_in	0 - 5 V	2.15k PU	Pin K013, Pullup to 5V
INPUT22	analog_in	0 - 5 V	2.15k PU	Pin K030, Pullup to 5V

Inputs (continued)

Resourse	Functions	Voltage Ranges	Pull-Downs/Ups	Note
INPUT23	analog_in	0 - 5 V	56.7k PD	Pin K034
INPUT24	analog_in	0 - 5 V	56.7k PD	Pin K035
INPUT25	analog_in	0 - 5 V	2.15k PU	Pin K042, Pullup to 5V
INPUT26	analog_in	0 - 5 V	681k PU	Pin K045, Pullup to 5V
INPUT27	analog_in	0 - 5 V	2.15k PU	Pin K051, Pullup to 5V
INPUT28	analog_in	0 - 5 V	2.15k PU	Pin K058, Pullup to 5V
INPUT29	analog_in	0 - 5 V	215k PD	Pin K065
INPUT30	analog_in	0 - 5 V	215k PD	Pin K082
INPUT31	analog_in	0 - 5 V	None	Pin K041
INPUT32	analog_in	0 - 5 V	None	Pin K075
INPUT33	digital_in		1.3k PD	Pin A057
INPUT34	digital_in		1.3k PD	Pin K047
INPUT35	digital_in		1.3k PD	Pin K049
INPUT36	digital_in		2.6k PU	Pin K014, Pullup to 5V
INPUT37	digital_in		1.3k PU	Pin K016, Pullup to 5V
INPUT38	digital_in		1.18k PU	Pin K017, Pullup to 5V
INPUT39	digital_in		1.3k PU	Pin K028, Pullup to 5V
INPUT40	digital_in		1.3k PU	Pin K033
INPUT41	freq_in		2.61k PU 46.4k PD	Pin A035, Max Frequency 300 Hz, Pullup to 5V
INPUT42	freq_in		1.47k	Pin K018, Max Frequency 33 kHz, Pullup to 5V
INPUT43	freq_in		1.3k PD 46.4k PD	Pin K029, Max Frequency 300 Hz
INPUT44	freq_in		2.61k PU 23.7k PD	Pin K048, Max Frequency 15 kHz, Pullup to 5V
INPUT45	freq_in		1.47k PU	Pin K052

Note: All analog inputs are 12 bit.

Outputs

Resource	Functions	Driver Types	Note
OUTPUT1	digital_out pwm_out output_status	Low Side	Pin A010, 2.2A(4A) Max
OUTPUT2	digital_out pwm_out output_status	Low Side	Pin A023, 3A(6A) Max
OUTPUT3	digital_out pwm_out output_status	Low Side	Pin A024, 2.2A(4A) Max
OUTPUT4	digital_out pwm_out output_status	Low Side	Pin A046, 2.2A(4A) Max
OUTPUT5	digital_out pwm_out output_status	Low Side	Pin A054, 2.2A(4A) Max
OUTPUT6	digital_out pwm_out output_status	Low Side	Pin A093, 3A(6A) Max
OUTPUT7	digital_out pwm_out output_status	Low Side	Pin K084, 2.2A(4A) Max
OUTPUT8	digital_out pwm_out output_status	Low Side	Pin K088, 2.2A(4A) Max
OUTPUT9	digital_out pwm_out output_status	Low Side	Pin A003, 4A(10A) Max,(O2 Heater - WB Sensor 2) Frequency 100 Hz
OUTPUT10	digital_out pwm_out output_status	Low Side	Pin A045, 3A(6A) Max (O2 Heater)
OUTPUT11	digital_out pwm_out output_status	Low Side	Pin K057, 3A(6A) Max (O2 Heater)
OUTPUT12	digital_out pwm_out output_status	Low Side	Pin A022, 4A(10A) Max, (O2 Heater - WB Sensor 1) Frequency 100 Hz
OUTPUT21	digital_out output_status	Low Side	Pin A004, 3A(8A) Max
OUTPUT22	digital_out output_status	Low Side	Pin A031, 2.2A Max

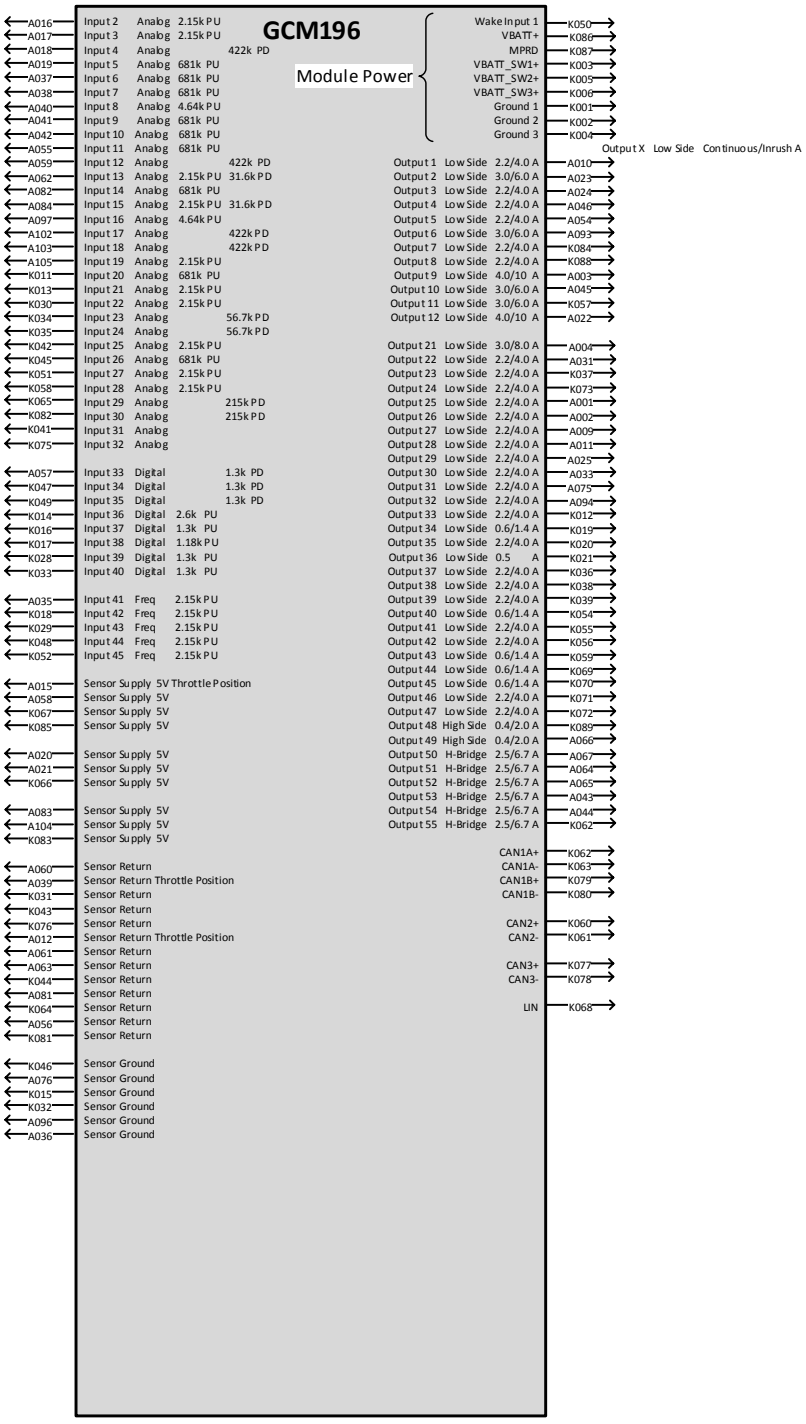
Outputs (continued)

Resource	Functions	Driver Types	Note
OUTPUT23	digital_out output_status	Low Side	Pin K037, 2.2A(4A) Max
OUTPUT24	digital_out output_status	Low Side	Pin K073, 2.2A(4A) Max
OUTPUT25	digital_out output_status	Low Side	Pin A001, 2.2A(4A) Max
OUTPUT26	digital_out output_status	Low Side	Pin A002, 2.2A(4A) Max
OUTPUT27	digital_out output_status	Low Side	Pin A009, 2.2A(4A) Max
OUTPUT28	digital_out output_status	Low Side	Pin A011, 2.2A(4A) Max
OUTPUT29	digital_out output_status	Low Side	Pin A025, 2.2A(4A) Max
OUTPUT30	digital_out output_status	Low Side	Pin A033, 2.2A(4A) Max
OUTPUT31	digital_out output_status	Low Side	Pin A075, 2.2A(4A) Max
OUTPUT32	digital_out output_status	Low Side	Pin A094, 2.2A(4A) Max
OUTPUT33	digital_out output_status	Low Side	Pin K012, 2.2A(4A) Max
OUTPUT34	digital_out	Low Side	Pin K019, 0.6A(1.4A) Max
OUTPUT35	digital_out output_status	Low Side	Pin K020, 2.2A(4A) Max
OUTPUT36	digital_out output_status	Low Side	Pin K021, 0.5A Max
OUTPUT37	digital_out output_status	Low Side	Pin K036, 2.2A(4A) Max
OUTPUT38	digital_out output_status	Low Side	Pin K038, 2.2A(4A) Max
OUTPUT39	digital_out output_status	Low Side	Pin K039, 2.2A(4A) Max
OUTPUT40	digital_out output_status	Low Side	Pin K054, 0.6A(1.4A) Max
OUTPUT41	digital_out output_status	Low Side	Pin K055, 2.2A(4A) Max
OUTPUT42	digital_out output_status	Low Side	Pin K056, 2.2A(4A) Max

Outputs (continued)

Resource	Functions	Driver Types	Note
OUTPUT43	digital_out output_status	Low Side	Pin K059, 0.6A(1.4A) Max
OUTPUT44	digital_out output_status	Low Side	Pin K069, 0.6A(1.4A) Max
OUTPUT45	digital_out output_status	Low Side	Pin K070, 0.6A(1.4A) Max
OUTPUT46	digital_out output_status	Low Side	Pin K071, 2.2A(4A) Max
OUTPUT47	digital_out output_status	Low Side	Pin K072, 2.2A(4A) Max
OUTPUT48	digital_out output_status	High Side	Pin K089, 0.4A(2A) Max
OUTPUT49	digital_out	High Side	Pin K053, 0.4A(2A) Max, Activated only w/ INPUT38 (K017) to GND.
OUTPUT50_51	hbridge_out output_status	H-Bridge	Pin A066 and A067, 2.5A(6.7A) Max, 300-25kHz
OUTPUT52_53	hbridge_out output_status	H-Bridge	Pin A064 and A065, 2.5A(6.7A) Max, 300-25kHz
OUTPUT54_55	hbridge_out output_status	H-Bridge	Pin A043 and A044, 2.5A(6.7A) Max
POWER_HOLD	digital_out	(None)	

System Diagram



Programming

Note: The ECU must be power cycled after programming to enable CAN 2 and CAN 3.

Power

The main power relay is not controllable from the application. It is low side and sinks 350 mA.

The ECU is not protected against a load-dump-pulse on the battery lines. The customer has to guarantee that in case of load dump pulses the voltages at the battery lines will be limited to ≤ 36 V (installation of protective measures, e.g. compact generator with central load dump diode).

The ECU is protected against reverse polarity supply voltage of U = 13.5 V for 5 min, if UBR (K03, K05, K06) is connected to battery voltage via main relay and the load contact of the main relay is open. This requirement ensures immunity to misconnected batteries when reverse voltage occurs on all supply lines simultaneously. No additional error of any connector is allowed (e.g. shortcut at the main relay).

Constant Battery Power (Pin Name: VBATT+)

	Min	Nom	Max	Units
Input Voltage: Normal Operation	6		16	V
Overvoltage Protection			38.5	V
Reverse Battery Protection			13.5	V
Current Draw: Off-State Current			70	uA

Switched Battery Power (Pin Name: VBATT_SW1+, VBATT_SW2+, VBATT_SW3+)

	Min	Nom	Max	Units
Input Voltage: Normal Operation	6		16	V
Overvoltage Protection			38.5	V
Reverse Battery Protection			13.5	V
Current Draw: Off-State Current			8.42	mA

Key Switch (Pin Name: WAKE_INPUT1)

	Min	Nom	Max	Units
High Switch Input	4.13			V
Low Switch Input			3.61	V

Sensor Power (Pin Name: SENSOR_SUPPLY+)

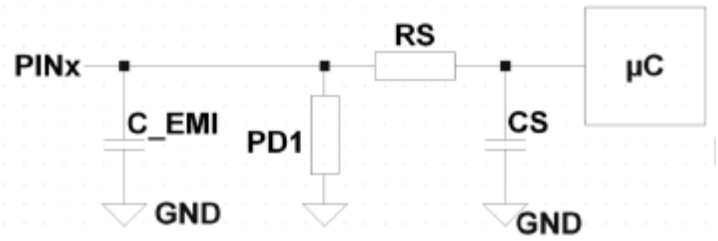
	Min	Nom	Max	Units
Output Voltage	4.9	5	5.1	V
Total output current among Sensor Supply1 pins (A015, A058, K067, K085)			150	mA
Total output current among Sensor Supply2 pins (A020, A021, K066)			150	mA
Total output current among Sensor Supply2 pins (A083, A104, K083)			150	mA

Analog Inputs

All analog inputs have the following properties:

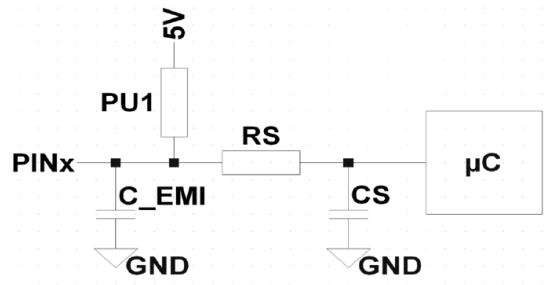
	Min	Nom	Max	Units
Input voltage range	0		5	V
Resolution			12	bits
Overvoltage			Vbatt	V
C_EMI	3.76		5.64	nF

Analog Input Type I (INPUTS 4, 12, 17, 18, 23, 24, 29, 30)



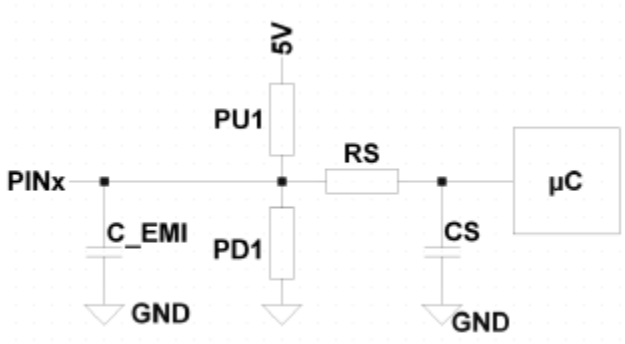
	Min	Nom	Max	Units
Cutoff frequency, Input 4, 12, 17, 18, 30	0.820		1.269	kHz
Cutoff frequency, Input 23, 24	1.188		1.838	kHz
Cutoff frequency, Input 29	0.805		1.244	kHz

Analog Input Type II (Inputs 2, 3, 8, 16, 19, 21, 22, 25, 27, 28)



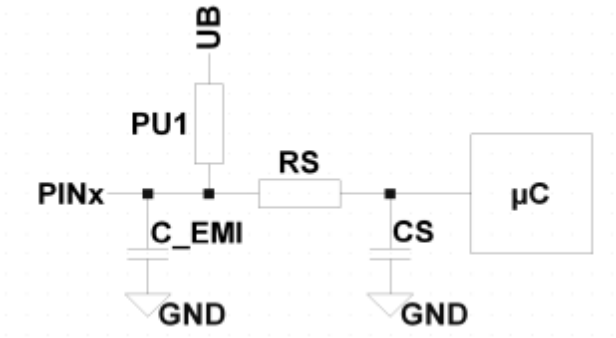
	Min	Nom	Max	Units
Cutoff frequency	1.188		1.838	kHz

Analog Input Type III (Inputs 13, 15)



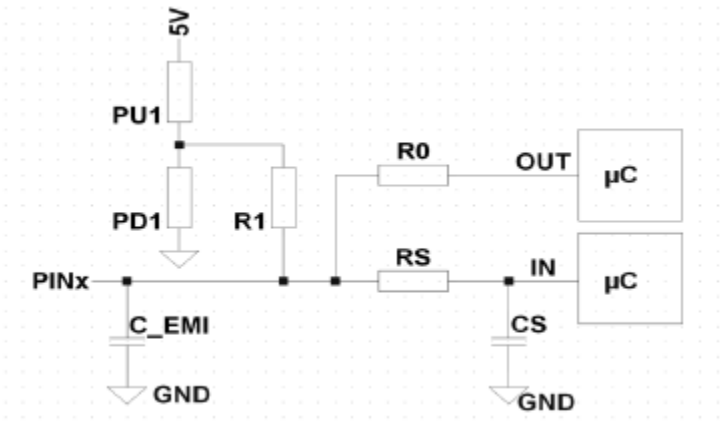
	Min	Nom	Max	Units
Cutoff frequency	1.188		1.838	kHz

Analog Input Type IV (Inputs 5, 6, 7, 9, 10, 11, 14, 20, 26)



	Min	Nom	Max	Units
Cutoff frequency	1.188		1.838	kHz

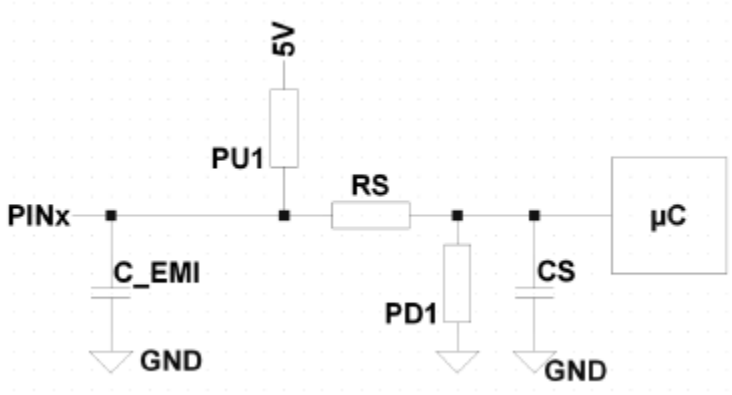
Analog Input Type V (Inputs 31, 32)



	Min	Nom	Max	Units
Cutoff frequency	3.4876		3.846	kHz
Open Circuit Voltage (Input 31)		0.18		V
Open Circuit Voltage (Input 32)		2.58		V
Gain		1.239e-3		V/count
Offset		0.007		V

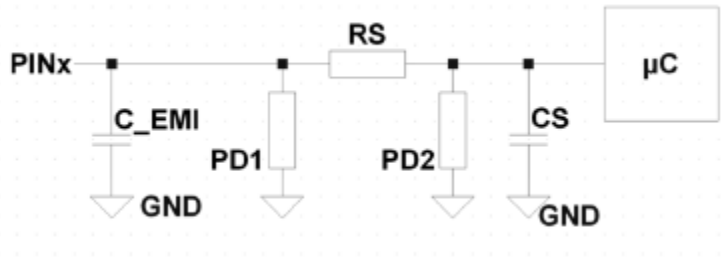
Digital Inputs

Digital Input Type I (Input 36)



	Min	Nom	Max	Units
Low logic threshold			1.76	V
High logic threshold	3.43			V
Cutoff frequency	210		265	kHz

Digital Input Type II (Inputs 34, 35)



Input 34

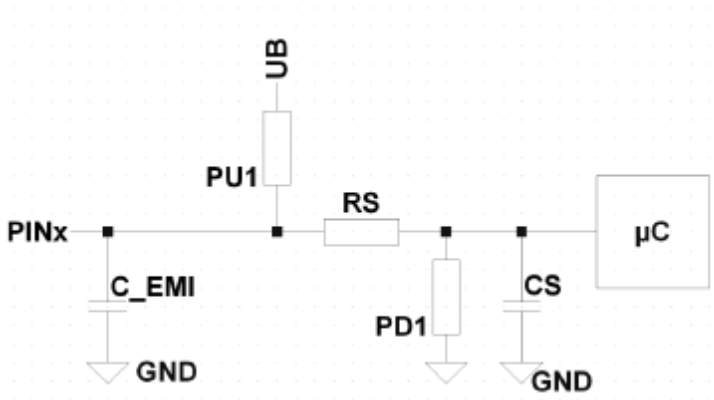
	Min	Nom	Max	Units
Low logic threshold			2	V
High logic threshold	4.42			V
Cutoff frequency	.753		1.164	kHz

Input 35

	Min	Nom	Max	Units

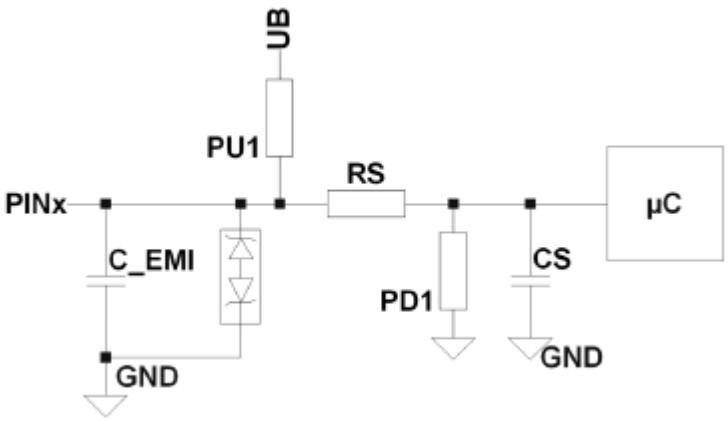
Low logic threshold			2.22	V
High logic threshold	4.19			V
Cutoff frequency	.753		1.164	kHz

Digital Input Type III (Inputs 37, 40)



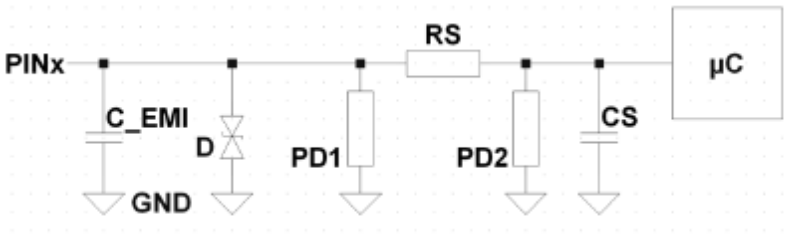
	Min	Nom	Max	Units
Low logic threshold			2.25	V
High logic threshold	4.17			V
Cutoff frequency	.753		1.164	kHz

Digital Input Type IV (Inputs 39)



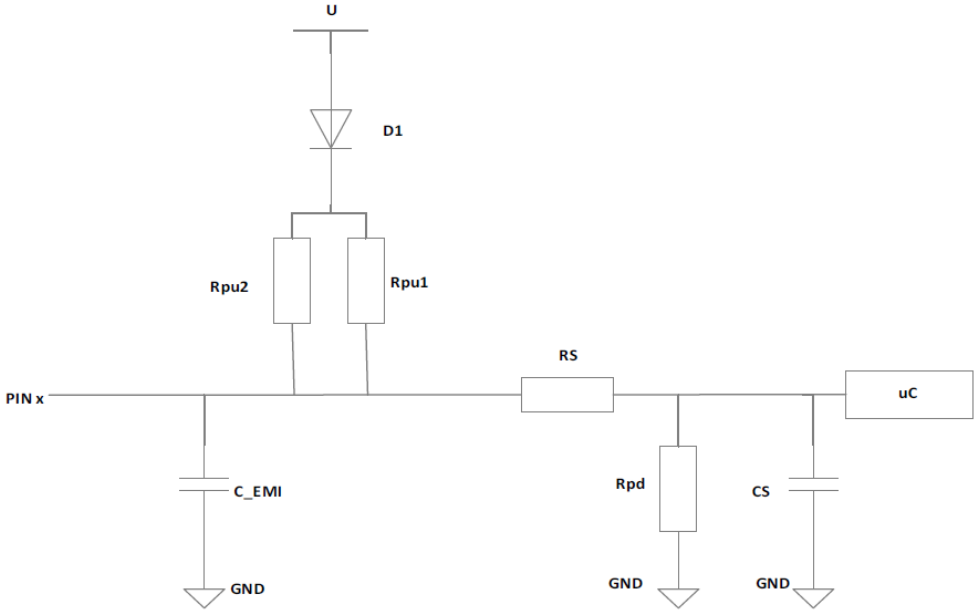
	Min	Nom	Max	Units
Low logic threshold			2	V
High logic threshold	4.42			V
Cutoff frequency	.753		1.164	kHz

Digital Input Type V (Inputs 33)



	Min	Nom	Max	Units
Low logic threshold			2.25	V
High logic threshold	4.17			V
Cutoff frequency	.753		1.164	kHz

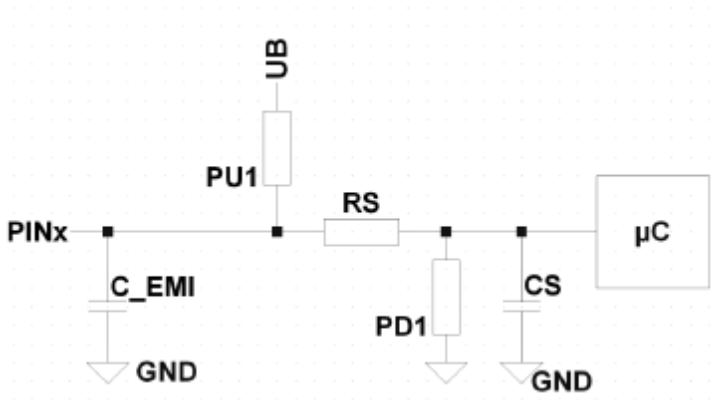
Digital Input Type VI (Inputs 38)



	Min	Nom	Max	Units
Low logic threshold			2.25	V
High logic threshold	4.17			V
Cutoff frequency	.753		1.164	kHz

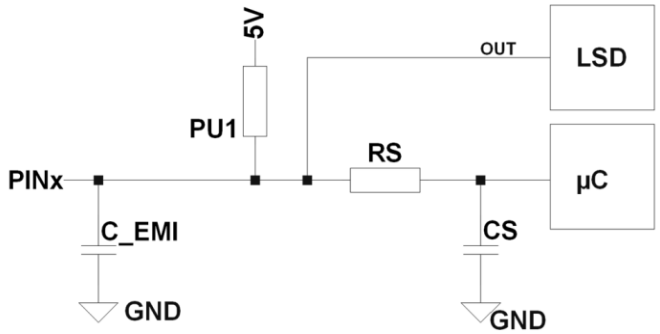
Frequency Inputs

Frequency Input Type I (Input 41)



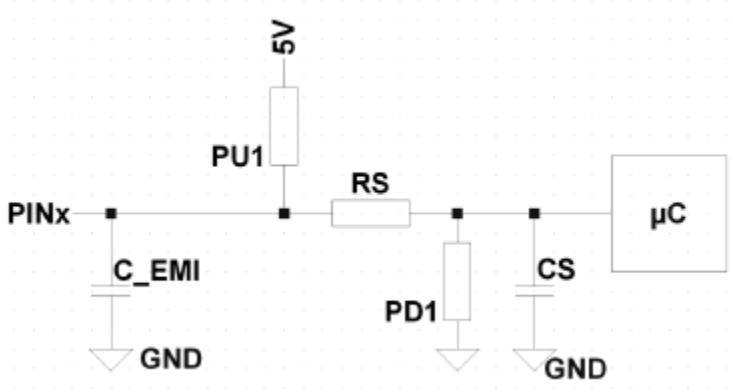
	Min	Nom	Max	Units
Low logic threshold			2.25	V
High logic threshold	4.17			V
Cutoff frequency	.753		1.164	kHz

Frequency Input Type II (Input 42, 45)



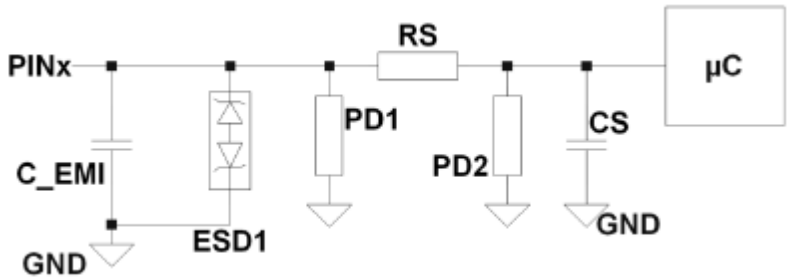
	Min	Nom	Max	Units
Low logic threshold			1.15	V
High logic threshold	2.04			V
Cutoff frequency	610		769	kHz

Frequency Input Type III (Input 44)



	Min	Nom	Max	Units
Low logic threshold			1.76	V
High logic threshold	3.43			V
Cutoff frequency	210		265	kHz

Frequency Input Type IV (Input 43)

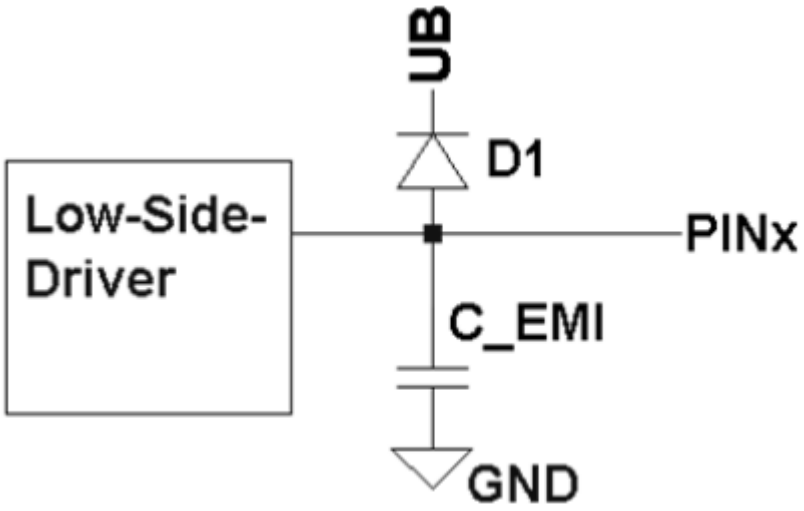


	Min	Nom	Max	Units
Low logic threshold			2.25	V
High logic threshold	4.17			V
Cutoff frequency	.753		1.164	kHz

Low Side Drives

PWM-capable low side drives have a frequency range of 38Hz to 20kHz.

Low Side Drives (Outputs 1, 2, 3, 4, 5, 6, 9, 10, 11, 12, 21, 22, 24, 25, 26, 27, 28, 29, 30, 32, 35, 38, 39, 42)



Outputs 1, 3, 4, 5, 22, 24, 24, 25, 26, 27, 28, 29, 30, 32, 35, 38, 39, 42

	Min	Nom	Max	Units
Output Current	0		2.2	A
Short Circuit Detection Current Threshold			4	A

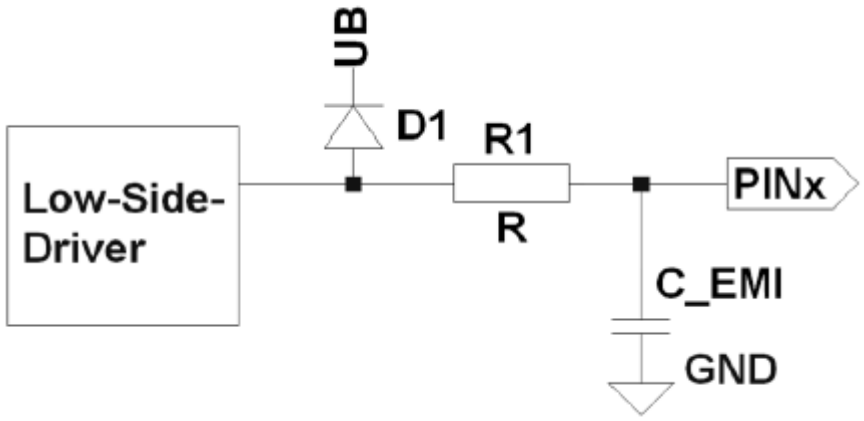
Outputs 9, 12, 21

	Min	Nom	Max	Units
Output Current	0		4	A
Short Circuit Detection Current Threshold			10	A

Outputs 2, 6, 10, 11

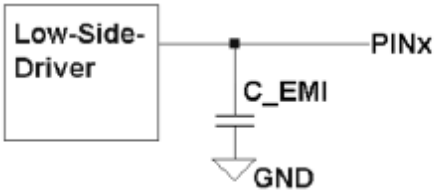
	Min	Nom	Max	Units
Output Current	0		3	A
Short Circuit Detection Current Threshold			6	A

Low Side Drive (Output 31)



	Min	Nom	Max	Units
Output Current	0		4	A
Short Circuit Detection Current Threshold			20	A

Low Side Drive (Outputs 7, 8, 13, 14, 15, 16, 17, 18, 19, 20, 23, 33, 34, 37, 40, 41, 43, 44, 45, 46, 47)



Outputs 7, 8, 17, 19, 20, 23, 33, 34, 37, 41, 46, 47

	Min	Nom	Max	Units
Output Current	0		2.2	A
Short Circuit Detection Current Threshold			4	A

Outputs 40, 43, 44, 45

	Min	Nom	Max	Units
Output Current	0		600	mA

Short Circuit Detection Current Threshold			1.4	A

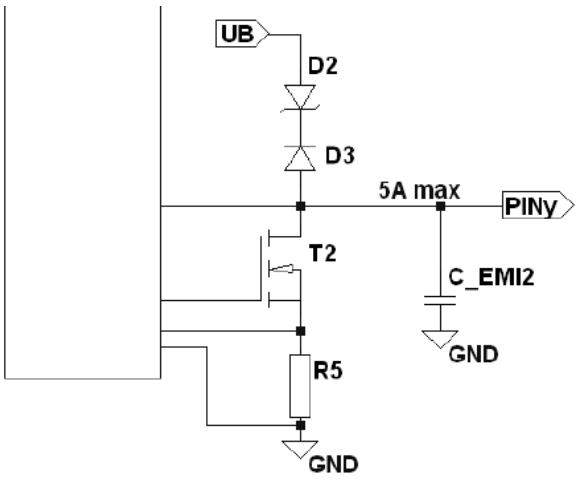
Outputs 13, 15, 18

	Min	Nom	Max	Units
Output Current	0		4	A
Short Circuit Detection Current Threshold			10	A

Output 14, 16

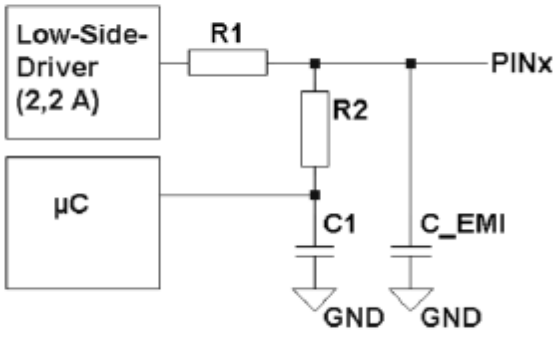
	Min	Nom	Max	Units
Output Current	0		3	A
Short Circuit Detection Current Threshold			6	A

Low Side Drive (Outputs 78, 79)



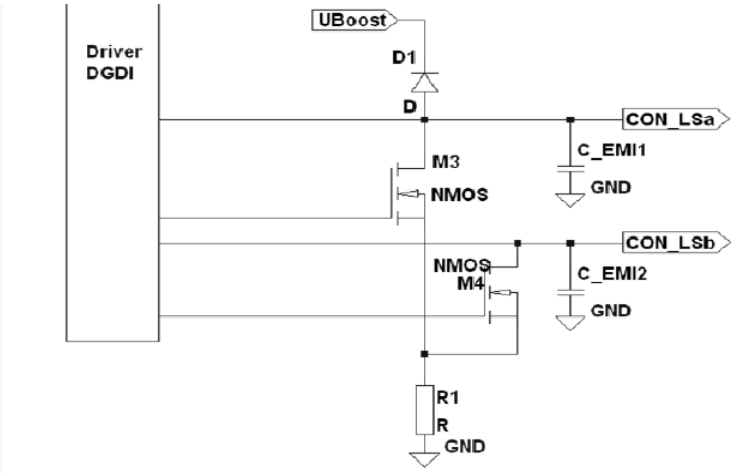
	Min	Nom	Max	Units
Pickup Current			10	A
Hold Current			4.5	A

Low Side Drive (36)



	Min	Nom	Max	Units
Output Current	0		477	mA
Short Circuit Detection Current Threshold			477	A

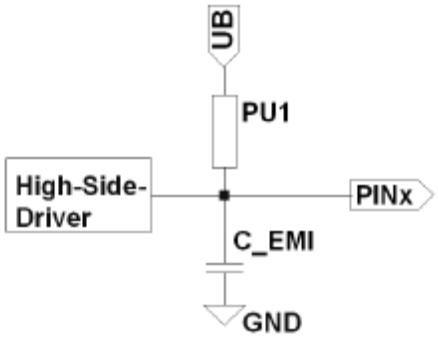
Low Side Drive (Outputs 70, 71, 72, 73, 74, 75, 76, 77)



	Min	Nom	Max	Units
Boost Current			15	A
Pickup Current			10	A
Hold Current			4.5	A

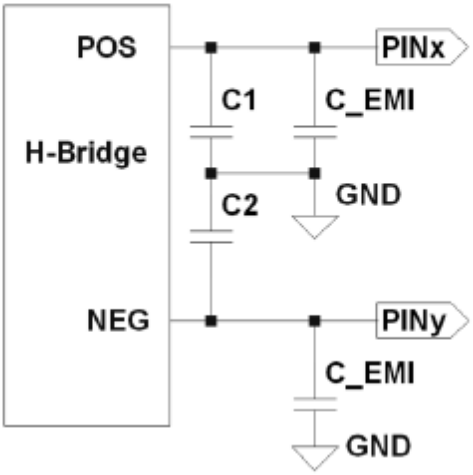
High Side Drives

High Side Drive (Outputs 48)



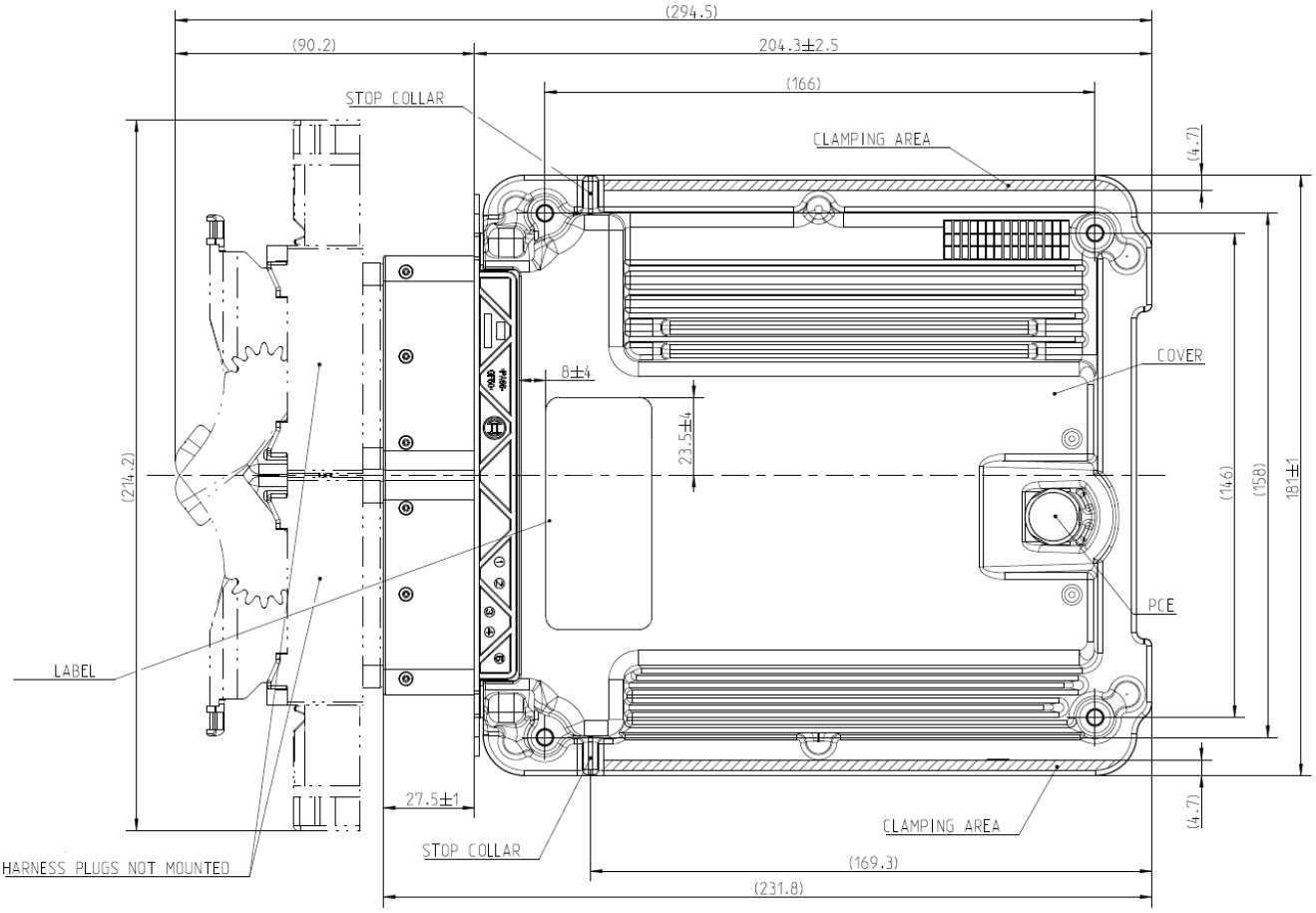
	Min	Nom	Max	Units
Output Current	0		400	mA
Short Circuit Detection Current Threshold			2	A

Half Bridges (Outputs 50 & 51, 52 & 53, 54 & 55)



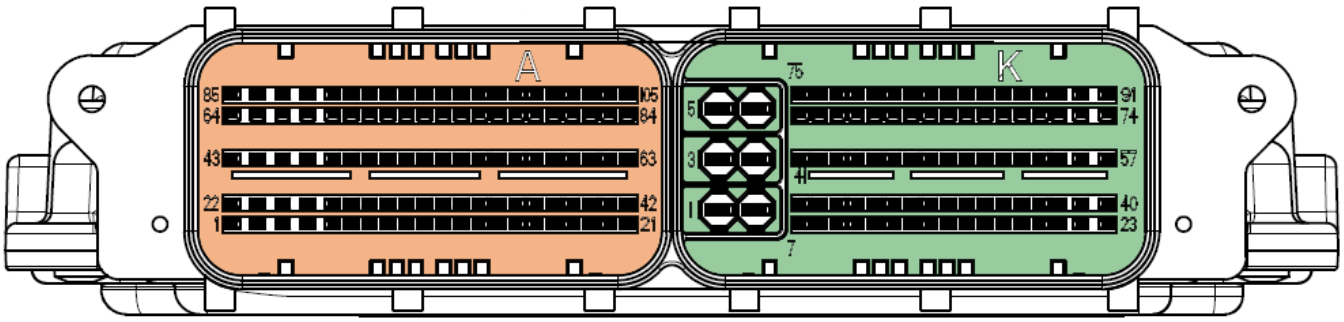
	Min	Nom	Max	Units
Output Current (RMS)	-2.5		2.5	Arms
Output Current (DC)	-7.6		7.6	A
Short Circuit Detection Current Threshold	-11.1		11.1	A
Frequency	306		40,000	Hz

Dimensions



Connections

The connector is split into two chambers, 105 pins for connector A and 91 pins for connector K. Contact New Eagle Distribution (NED) to purchase a connector kit quotes@neweagle.net



Pinout

Connector A Pinout					
Pin	Function	Pin	Function	Pin	Function
1	OUTPUT25	36	SENSOR_GND	71	Not Connected
2	OUTPUT26	37	INPUT6	72	Not Connected
3	OUTPUT9	38	INPUT7	73	Not Connected
4	OUTPUT21	39	SENSOR_RETURN	74	Not Connected
5	Not Connected	40	INPUT8	75	OUTPUT31
6	Not Connected	41	INPUT9	76	SENSOR_GND
7	Not Connected	42	INPUT10	77	Not Connected
8	Not Connected	43	OUTPUT54	78	Not Connected
9	OUTPUT27	44	OUTPUT55	79	Not Connected
10	OUTPUT1	45	OUTPUT10	80	Not Connected
11	OUTPUT28	46	OUTPUT4	81	SENSOR_RETURN
12	SENSOR_RETURN	47	Not Connected	82	INPUT14
13	Not Connected	48	Not Connected	83	SENSOR_SUPPLY
14	Not Connected	49	Not Connected	84	INPUT15
15	SENSOR_SUPPLY	50	Not Connected	85	Not Connected
16	INPUT2	51	Not Connected	86	Not Connected
17	INPUT3	52	Not Connected	87	Not Connected
18	INPUT4	53	Not Connected	88	Not Connected
19	INPUT5	54	OUTPUT5	89	Not Connected
20	SENSOR_SUPPLY	55	INPUT11	90	Not Connected
21	SENSOR_SUPPLY	56	SENSOR_RETURN	91	Not Connected
22	OUTPUT12	57	INPUT33	92	Not Connected
23	OUTPUT2	58	SENSOR_SUPPLY	93	OUTPUT6
24	OUTPUT3	59	INPUT12	94	OUTPUT32
25	OUTPUT29	60	SENSOR_RETURN	95	Not Connected
26	Not Connected	61	SENSOR_RETURN	96	SENSOR_GND
27	Not Connected	62	INPUT13	97	INPUT16
28	Not Connected	63	SENSOR_RETURN	98	Not Connected
29	Not Connected	64	OUTPUT52	99	Not Connected
30	Not Connected	65	OUTPUT53	100	Not Connected
31	OUTPUT22	66	OUTPUT50	101	Not Connected
32	Not Connected	67	OUTPUT51	102	INPUT17
33	OUTPUT30	68	Not Connected	103	INPUT18
34	Not Connected	69	Not Connected	104	SENSOR_SUPPLY
35	INPUT41	70	Not Connected	105	INPUT19

Connector K Pinout					
Pin	Function	Pin	Function	Pin	Function
1	GND1	32	SENSOR_GND	63	CAN1A_LO
2	GND2	33	INPUT40	64	SENSOR_RETURN
3	VBATT_SW1+	34	INPUT23	65	INPUT29
4	GND3	35	INPUT24	66	SENSOR_SUPPLY
5	VBATT_SW2+	36	OUTPUT37	67	SENSOR_SUPPLY
6	VBATT_SW3+	37	OUTPUT23	68	LIN
7	Not Connected	38	OUTPUT38	69	OUTPUT44
8	Not Connected	39	OUTPUT39	70	OUTPUT45
9	Not Connected	40	Not Connected	71	OUTPUT46
10	Not Connected	41	INPUT31	72	OUTPUT47
11	INPUT20	42	INPUT25	73	OUTPUT24
12	OUTPUT33	43	SENSOR_RETURN	74	Not Connected
13	INPUT21	44	SENSOR_RETURN	75	INPUT32
14	INPUT36	45	INPUT26	76	SENSOR_RETURN
15	SENSOR_GND	46	SENSOR_GND	77	CAN3_HI
16	INPUT37	47	INPUT34	78	CAN3_LO
17	INPUT38	48	INPUT44	79	CAN1B_HI
18	INPUT42	49	INPUT35	80	CAN1B_LO
19	OUTPUT34	50	WAKE_INPUT1	81	SENSOR_RETURN
20	OUTPUT35	51	INPUT27	82	INPUT30
21	OUTPUT36	52	INPUT45	83	SENSOR_SUPPLY
22	Not Connected	53	OUTPUT49	84	OUTPUT7
23	Not Connected	54	OUTPUT40	85	SENSOR_SUPPLY
24	Not Connected	55	OUTPUT41	86	VBATT+
25	Not Connected	56	OUTPUT42	87	MPRD
26	Not Connected	57	OUTPUT11	88	OUTPUT8
27	Not Connected	58	INPUT28	89	OUTPUT48
28	INPUT39	59	OUTPUT43	90	Not Connected
29	INPUT43	60	CAN2_HI	91	Not Connected
30	INPUT22	61	CAN2_LO		
31	SENSOR_RETURN	62	CAN1A_HI		

Minimum Programming Harness

Connector K					
Pin	Function	Pin	Function	Pin	Function
1	GND1	60	CAN2_HI	77	CAN3_HI
5	VBATT_SW2+	61	CAN2_LO	78	CAN3_LO
15	SENSOR_GND	62	CAN1A_HI		
50	WAKE_INPUT1	63	CAN1A_LO		